

EXPERIMENTAL STUDY OF THE SPACE-TIME DEVELOPMENT OF THE  
PARTICLE PRODUCTION PROCESS IN HADRON-NUCLEON COLLISIONS,  
USING MASSIVE TARGET NUCLEUS AS A DETECTOR

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ABSTRACT

Experimental study of the space-time development of the particle production process in hadronic collisions at its initial stage was performed. Massive target nuclei have been used as fine detectors of properties of the particle production process development within time intervals smaller than  $10^{-22}$  s and spatial distances smaller than  $10^{-12}$  cm. In hadron-nucleon collisions, in particular in nucleon-nucleon collisions, the particle production process goes through intermediate objects in  $2 \rightarrow 2$  type endoergic reactions. The objects decay into commonly observed resonances and particles.

1. Introduction

In searches for plausible mechanisms to explain the particle production in hadron-nucleon collisions, in nucleon-nucleon collisions in particular, characteristics of the collision reaction products appeared after relatively long time after the collision - not shorter than the life times of resonances - are usually analysed. It cannot be excluded a priori that the known particles and resonances are the decay products of some super-particle or super-particles created firstly as well.

Now experimental information is needed, adequate and of a new quality - relevant to the time intervals  $\tau$  of the most short-living particles known up to now, and within the spacial distances  $z$  much smaller than  $\tau c \gamma$ , where  $\gamma$  accounts the Lorentz dilatation of the lifetime in the laboratory.

The shortest decay times of the known resonances are  $\tau_s \approx 10^{-23}$  s which corresponds to the smallest spacial distances  $z$  of some  $10^{-13}$  cm in the laboratory, when  $\gamma \approx 1$ . So, the qualitatively new and adequate information which has to be used for elucidation of the process in question should be obtained at the times

$\tau \leq 10^{-22}$  s within the spacial distances  $z \leq 10^{-12}$  cm. These space distances and time intervals we shall call "short". Experimental information about the particle production process obtained at larger time intervals and spacial distances only may yield false ideas of the collision reaction products and of the particle systematics in a whole as well.

The collision reaction products appeared in the initial stage - within the short time intervals and spacial distances - should interact with a surrounding medium and the interaction must produce observable effects, if one would study these products experimentally. The only tool available now to realize such experiments is to apply massive target nuclei as fine detectors, therefore, Strugalski Z. (1980, 1981, 1982 a);

The subject matter in this paper is to present results of our experimental study of the space-time development of the particle production process in hadronic collisions at its initial stage. In the study, our own experimental data on pion-xenon nucleus collisions obtained at 2 - 9 GeV/c momentum, Miller K. et al. (1976), Pluta J. et al. (1976), Okhrimenko L. et al. (1978), Strugalski Z. et al. (1974, 1981, 1982 a-c, 1983 a-g) and the wealth of experimental data on hadron-nucleus, Bannik B.P. et al. (1980), Busza W. (1975), Faessler M.A. et al. (1979), Gurtu A. et al. (1974 a and b), Otterlund I. et al. (1978), Tsai-Chü et al. (1977) and the data on hadron-nucleon collisions, Famino V. et al. (1979), Goldschmidt-Clermont Y. (1973), collected in the past by other physicists were used.

## 2. Method

The atomic nucleus used as the target in hadron-nucleus collisions serves as a fine detector. Its size  $r_A$  can be roughly up to about 10 fm, Elton L.R.B. (1961). The basic physical process underlying the operation principle of this fine detector is the emission of nucleons, Strugalski Z. (1983, 1984). Information in details about the method can be found in one of my papers, Strugalski Z. (1985).

## 3. Results

In result of the investigations performed, we can conclude that:

1. In hadron-nucleus collisions, particles are produced via some intermediate objects which decay after having left the parent nucleus into usually observed resonances and particles. We called these objects "generons".

2. It is reasonable to think that the particle production in elementary hadron-nucleon collisions, in nucleon-nucleon collisions in particular, goes through such intermediate objects as well, in endoergic  $2 \rightarrow 2$  type reaction; the objects decay into commonly known resonances and particles.

It has been shown that the above presented mechanism of the particle production process allows to derive formulas which in a convincing manner can account for hadron-nucleus data in terms of our knowledge of hadron-nucleon data, Strugalski Z. (1982 b).

#### 4. Remarks

The consequences of the picture of the particle production process, presented above, were proved experimentally, Strugalski Z. (1982 a), Sredniawa B. and Strugalska-Gola E. (1983, 1984), in hadron-nucleus collisions within incident hadron energy values from a few up to a few thousands GeV. Quantitative agreement of the predictions based on the picture presented with corresponding experimental data has been found.

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